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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/805,966	03/22/2004	Vikram Singh	2003-42/43	2603

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Mark Superko, Esq.
Varian Semiconductor Equipment Associates, Inc.
35 Dory Road
Gloucester, MA 01930

EXAMINER
ALEJANDRO MULERO, LUZ L

ART UNIT	PAPER NUMBER
1792	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/805,966	SINGH ET AL.	
	Examiner	Art Unit	
	Luz L. Alejandro	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 December 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,6-9,11-16,18-21,24,25,27,28,30-36,38 and 40* is/are pending in the application.

4a) Of the above claim(s) *6* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,7-9,11-16,18-21,24,25,27,28,30-36,38 and 40* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/10/09 has been entered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, 7-8, 11-12, 19-21, 35, and 38 is rejected under 35 U.S.C. 102(b) as being anticipated by Tomioka et al., U.S. Patent 5,897,713.

Tomioka et al. shows the invention as claimed including a plasma apparatus comprising: a plasma chamber 1 configured to receive a process gas; a radio frequency (RF) source (57a-57d) configured to generate RF current; an RF antenna unit including an active antenna (55a-55b) and a parasitic antenna (55a-55d), the active antenna surrounding the plasma chamber, including a first end electrically coupled to the RF source to receive the RF current from the RF source, and including a second

end coupled to ground, the parasitic antenna surrounding the plasma chamber, wherein the parasitic antenna is not electrically coupled to the RF source; and a platen 58 configured to hold a target 59, wherein each antenna of the RF antenna unit resonates RF current and includes electromagnetic field that is effective to pass into the plasma chamber and that excites and ionizes the process gas to generate a plasma within the plasma chamber, the plasma comprising ions (see figs. 8-13 and their descriptions).

Concerning claims 2-3, note that the active antenna includes a horizontally-extended coil and the parasitic antenna includes a vertically-extending coil.

With respect to claim 4, note that the apparatus of Tomioka et al. includes a parasitic antenna (for example, 55b) that includes a plurality of turns with one end grounded.

Regarding claim 7, note that one of the active and parasitic antennas of the RF antenna unit is a horizontally extending coil having a plurality of windings and wherein a diameter of innermost winding of the horizontally extending coil in a lateral direction is greater than a size of the target in the lateral direction.

With respect to claim 8, note that the parasitic antenna can be considered to be above and coaxial with the active antenna.

Concerning claim 11, the plasma chamber includes: a horizontal planar section positioned above the platen; a vertical cylindrical section extending from the horizontal planar section; and a top section coupled to the vertically cylindrical section.

Regarding claim 12, the apparatus of Tomioka et al. also includes a horizontal planar section and vertical cylindrical section that contain a dielectric 52, and is the top section is conductive and grounded (see fig. 10, for example).

With respect to claims 19-21, note that the RF source can operate at 2 MHz (see, for example, col. 9-line 30).

Concerning claim 35, note that the horizontally and vertically extending coils have a plurality of windings.

Regarding claim 38, Tomioka et al. shows the invention as claimed including a plasma apparatus comprising: a plasma chamber configured to receive a process gas; a radio frequency (RF) source configured to generate RF current; an RF antenna unit including a horizontally-extending active antenna coil (55a-55d) and a vertically extending parasitic antenna coil (55a-55b), the horizontally-extending active antenna coil that includes a first end coupled to the RF source 39 to receive the RF current from the RF source, the vertically-extending parasitic antenna coil being without an electrical connection to a power source; and a platen 58 configured to hold a target, wherein the vertically-extending parasitic antenna coil induces an RF current into the plasma chamber and excites and ionizes a process gas so as to generate a plasma in the plasma chamber, the plasma comprising ions.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Ishimaru, U.S. Patent 5,681,418.

Tomioka et al. is applied as above but does not expressly disclose wherein at least one antenna is liquid cooled. Ishimaru discloses forming a coil 40 which flows liquid water coolant therethrough (see col. 5-lines 13-21). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et al. so as to liquid cool the antenna because in such a way overheating of the antenna can be prevented.

Claims 13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Fitzsimmons et al., U.S. Patent 6,626,188.

Tomioka et al. is applied as above but does not expressly disclose wherein the ceramic material is one from a list including aluminum nitride of high purity. Fitzsimmons et al. discloses having aluminum nitride walls exposed to the plasma within the chamber (see fig. 3 and its description). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Kadomura and Collins et al. so as to form aluminum nitride in the plasma chamber because in such a way beneficial results will be produced such as the reduction of contamination.

Regarding the ceramic material being of high purity, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et al. modified by Fitzsimmons to use a high quality aluminum nitride material because in such a way the properties of the material will be improved and the apparatus lifetime will also be improved.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Collins et al., U.S. Patent 5,556,501.

Tomioka et al. is applied as above but does not expressly disclose wherein the top conductive section is made of aluminum. Collins et al. discloses a plasma apparatus wherein a top conductive section 17T is made of aluminum and grounded

(see fig. 1 and its description). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Kadomura so as to comprise the top conductive section of Collins et al. because this will allow the improvement of process uniformity.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Trow et al., US 5,824,607.

Tomioka et al. is applied as above but does not expressly disclose wherein the top section is liquid cooled. Trow et al. further discloses where a top conductive section of the apparatus is cooled by liquid (see col. 4-lines 40-50). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et al. so as to cool by liquid because liquid is shown to be an adequate means of cooling a top conductive member of a plasma apparatus.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Collins, U.S. Patent 5,707,486.

Tomioka et al. is applied as above but does not expressly disclose a gas source controller for maintaining a pressure of a plasma chamber at a predetermined value. Collins discloses a controller for controlling the pressure of a plasma chamber (see col. 13-lines 6-20). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et

al. so as to include the controller of Collins to control the pressure of the plasma chamber because such a device would allow for greater controllability over the process performed within the apparatus.

Claims 36 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Okumura et al., US 5,888,413, Chen et al., US 6,527,912 or Becker et al., US 6,899,817.

Tomioka et al. does not expressly disclose the claimed coil adjuster for adjusting a number of turns of the parasitic antenna. Okumura et al. discloses a coil adjuster 72/64,66/82,83/93 for adjusting the length and the number of turns of a coil (see figs. 13, 20-23 and their descriptions). Chen et al. discloses a coil adjuster 117 for adjusting the length and the number of turns of a coil (see figs. 2, 6 and 8, and their descriptions). Becker et al. discloses a coil adjuster 24/25 for adjusting the length and the number of turns of a coil (see fig. 2 and its description). In view of these disclosures, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et a l. so as to allow the coils to have their lengths and turns adjusted as suggested by Okumura et al., Chen et al. or Becker et al. because in such a way the plasma density can be effectively controlled and adjusted.

Claims 24-25, 27-28, 31, and 33-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Trow et al., US 5,824,607 or Collins et al., U.S. Patent 5,556,501.

Tomioka et al. shows the invention substantially as claimed including a plasma chamber comprising: a horizontal planar dielectric section for positioning above a platen; a vertical cylindrical dielectric section extending from the horizontal planar section; and a radio frequency antenna including a horizontally-extending coil (55a-55d) positioned proximate to the horizontal planar dielectric section and a vertically-extending coil (55a-55b) positioned proximate to the vertical cylindrical dielectric section, wherein one of the horizontally-extending coil and the vertically-extending coil comprises an active radio frequency antenna that is electrically coupled to an RF source and other one of the horizontally-extending coil and the vertically-extending coil comprises a parasitic antenna that is not electrically coupled to the RF source, the active radio frequency antenna and the parasitic antenna of the radio frequency antenna including radio frequency currents into the plasma chamber that excite and ionize a process gas so as to generate a plasma in the plasma chamber (see figs. 8-13 and their descriptions).

Tomioka et al. does not expressly disclose a liquid cooled top conductive section. Trow et al. discloses where a top conductive section of the apparatus is cooled by liquid (see col. 4-lines 40-50). Additionally, Collins et al. discloses a plasma chamber comprising a cooled top conductive section 17T coupled to a vertical dielectric section 17W (see fig. 1 and its description). In view of these disclosures, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et al. so as to include a liquid cooled top conductive section coupled to the vertical dielectric section as disclosed by Collins et al. or Trow et al.,

because in such a way the coupling of the plasma with the wafer will be improved while at the same time having improved controllability of the temperature of the chamber walls, and because liquid is shown to be an adequate means of cooling a top conductive member of a plasma apparatus.

Concerning claim 25, note that in the apparatus of Tomioka et al. modified by Trow et al. or Collins et al., the top conductive section is grounded (see Collins et al. at col. 21-lines 60-67).

With respect to claim 31, note that in the apparatus of Tomioka et al. modified by Trow et al or Collins et al., the horizontally extended coil is capable of being coupled to an RF source.

Regarding claims 33-34, note that the apparatus of Tomioka et al. modified by Trow et al. or Collins et al. discloses: wherein the horizontally-extending coil is spaced apart from the target by a first height in a vertical direction and the vertically-extending coil is spaced apart from the target by a second height in the vertical direction, the first height being less than the second height. Furthermore, the apparatus of Tomioka et al. modified by Trow et al. or Collins et al. also discloses: wherein the horizontally-extending coil has a plurality of windings and spaced apart from the target by a first height in a vertical direction, and wherein a diameter of the innermost winding in a lateral direction is greater than the size of the target in the lateral direction.

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Trow et al., US 5,824,607 and Collins et al., U.S.

Patent 5,556,501, as applied to claims 24-25, 27-28, 31, and 33-34 above, and further in view of Ishimaru, U.S. Patent 5,681,418.

Tomioka et al., Trow et al., and Collins et al. are applied as above but do not expressly disclose wherein at least one antenna is liquid cooled. Ishimaru discloses forming a coil 40 which flows liquid water coolant therethrough (see col. 5-lines 13-21). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et al. modified by Trow et al and Collins et al. so as to liquid cool the antenna because in such a way overheating of the antenna can be prevented.

Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al., U.S. Patent 5,897,713 in view of Trow et al., US 5,824,607 and Collins et al., U.S. Patent 5,556,501 as applied to claims 24-25, 27-28, 31, and 33-34 above, and further in view of Kumagai, U.S. Patent 5,916,455.

Tomioka et al., Trow et al., and Collins et al., are applied as above but do not expressly disclose a strike gas inlet. Kumagai discloses a strike gas inlet (see ignition chamber 30) whereby plasma is ignited and expelled into the inductively coupled plasma chamber (see fig. 1-2 and their descriptions). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Tomioka et al. modified by Trow et al. and Collins et al., so as to comprise a strike gas inlet because in such a way plasma will be more easily ignited for processing within the apparatus.

Response to Arguments

Applicant's arguments with respect to claims 1-4, 7-9, 11-16, 18-21, 24-25, 27-28, 30-36, 38, and 40 have been considered but are moot in view of the new ground(s) of rejection. Furthermore, applicant's arguments and declaration with respect to the Kadomura references are persuasive and those references are withdrawn.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luz L. Alejandro whose telephone number is 571-272-1430. The examiner can normally be reached on Monday to Thursday from 7:30 to 6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Luz L. Alejandro/
Primary Examiner
Art Unit 1792

January 15, 2010